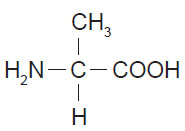
**Constitutional isomers and stereoisomers**

**1.** Alanine is an amino acid. Its structure is shown below.

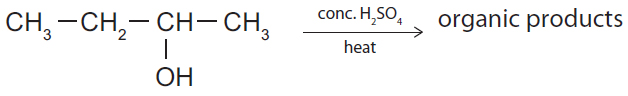


(a) (i) Describe the structural feature necessary for a compound to exist as enantiomers (optical isomers).

(ii) Identify one physical property that is the same for both enantiomers of alanine, and one that is different, clearly describing how this property could be used to distinguish between the enantiomers.

(b) Draw 3-D structures of the enantiomers of alanine.

**2.** When butan-2-ol undergoes a reaction with concentrated H2SO4, three possible organic products form, which are isomers of each other.



**i)** Draw the three isomers formed during this reaction.

**ii)** Which of the three isomers from part (i) will be formed in the smallest amount? Explain your answer.

**3. a)** The alcohol below can exist as two enantiomers (optical isomers).

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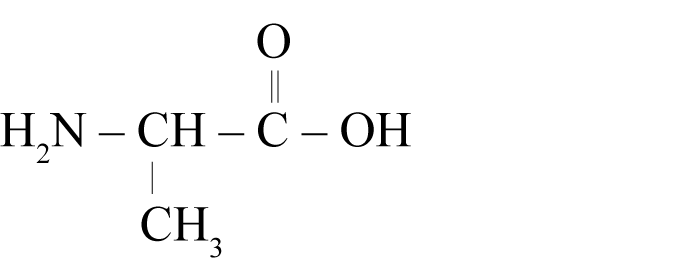
**i)** Draw three-dimensional structures for the two enantiomers.

**ii)** Link the structure of enantiomers to a physical property that can be used to distinguish them from non-optically active molecules.

**b)** Draw the structural formulae of three different isomers of

|  |  |
| --- | --- |
|  | • Isomer 1 turns moist blue litmus paper red.  • Isomer 2 is an ester.  • Isomer 3 is a ketone. |

**4.** The amino acid alanine below can exist as two enantiomers (optical isomers).



**i)** Draw three-dimensional structures for the two enantiomers that clearly show the relationship between

them.

**ii)** Alanine has two straight chain isomers that do not show acidic properties. One of these isomers, **P**, can

exist as an enantiomer, the other isomer, **Q**, cannot. Draw **P** and **Q.**

**iii)** Explain why **P** exists as an enantiomer

**5.** An alcohol **A** with the molecular formula C4H10O can exist as enantiomers (optical isomers).

**i)** State the structural requirement for a molecule to be able to exist as enantiomers.

**ii)** Describe a property of enantiomers that would enable them to be distinguished from each other.

**iii)** Draw the structural formulae of the enantiomers of alcohol **A**.

**6.** Compound A is a carboxylic acid with the molecular formula C4H8O2.   
i) Draw the structural formula for the isomers of **Compound A** (they are an alkene, aldehyde and ester)

**ii) Identify** an isomer of Compound Athat can exist as a pair of enantiomers (optical isomers) and justify your choice

**7. i)** Draw a circle around the product of the reaction below that will show optical isomerism (exist as

enantiomers). Give a reason for your answer.



**ii)** Explain how the two enantiomers of the compound circled above could be distinguished from each other.

**8.** C5H11OH is an example of an alcohol that can exist as a number of different isomers.

**a)** Draw structures of the isomers of C5H11OH that satisfy the requirements of

**i)** a branched-chain secondary alcohol **(A)** and **ii)** a branched-chain tertiary alcohol **(B)**

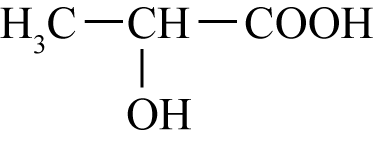
**b)** Explain why  is the only primary alcohol isomer of C5H11OH that is able to exist as a pair of enantiomers (optical isomers).

**9. i)** Draw structural formulae for all the possible constitutional (structural) isomers of C4H10O that are alcohols.

**ii)** Circle any isomer above that can exist as a pair of enantiomers (optical isomers).

**iii)** Explain what physical property would allow the two enantiomers to be distinguished.

**10.** Lactic acid is the common name for 2-hydroxypropanoic acid. Lactic acid can exist as enantiomers (optical isomers)



**a)** Draw three-dimensional structures for the two enantiomers of lactic acid that clearly show the

relationship between them.

**b)** Compound **X** is a structural isomer of lactic acid. Compound **X** will turn blue litmus red but cannot

exist as enantiomers.

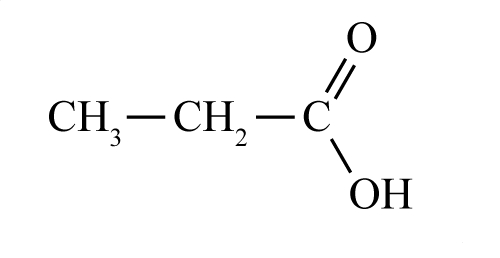
**i)** Draw the structural formula for Compound **X**.

**ii)** Explain why this structure cannot exist as enantiomers

**11.** An alcohol (C4H10O) can exist as **optical** isomers (enantiomers).

**i)** Draw three-dimensional structures that show the relationship between the two enantiomers.

**ii)** Draw and name a **structural** (constitutional) isomer of



**iii)** Discuss the differences in chemical and physical properties between samples of these two structural

isomers.

**12. a) Compound A** is an isomer of **C4H8O** and can exist as two **enantiomers** (optical isomers). It

contains two different functional groups – an alcohol (OH–) group and an alkene group.

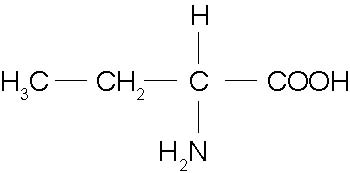
Draw 3-dimensional structures for **both enantiomers** that clearly show the relationship between them.

**b)** Two compounds **(B and C)** have the same molecular formula, C4H8O. They are ***cis-trans*** **isomers** that

contain a primary alcohol group. Both compounds rapidly decolourise bromine solution. Draw the

structural formulae of compounds B and C.

**13.**

**i)** Compound can exist as two optical isomers (enantiomers). Draw 3

dimensional structures that clearly show the relationship between the two enantiomers.

**ii)** Describe similarities and differences in the chemical and physical properties of the enantiomers

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